Boosting the performance and durability of Ni/YSZ cathode for hydrogen production at high current densities via decoration with nano-sized electrocatalysts

Conventional Ni/yttria-stabilized zirconia (YSZ) electrodes in solid oxide cells experience fast degradation when operated for the electrolysis of steam at high current densities. This study presents a relatively simple procedure of infiltrating Ce$_{0.8}$Gd$_{0.2}$O$_{2-δ}$ (CGO) nanoparticles into the Ni/YSZ electrode to achieve a stable cell performance. The long-term durability tests of the cells with a bare Ni/YSZ electrode and a CGO-infiltrated Ni/YSZ electrode were performed at 800 °C and -1.25 A cm$^{-2}$. The cell stability was investigated by measuring the cell voltage and obtaining the electro-chemical impedance spectra. The post-mortem analysis of the tested cells was conducted via scanning and transmission electron microscopy. The CGO nanoparticle infiltration reduced the cell voltage degradation rate from 699 mV kh$^{-1}$ for the bare Ni/YSZ electrode to 66 mV kh$^{-1}$ for the infiltrated electrode. The investigation showed that after introducing CGO nanoparticles, the steam reduction mechanism changed, and the electrode degradation originated from different mechanisms than that for the bare Ni/YSZ electrode.

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